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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/919,511	07/31/2001	Leslie L. Deck	09712-116001	2774

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EXAMINER	
LEE, SHUN K	

ART UNIT	PAPER NUMBER
2878	

DATE MAILED: 01/08/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/919,511	DECK, LESLIE L.	
	Examiner	Art Unit	
	Shun Lee	2878	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *24 November 2003*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-32 and 39* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-16,27,28,30-32 and 39* is/are rejected.

7)☒ Claim(s) *17-26 and 29* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *31 July 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

13)☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

a) ☐ The translation of the foreign language provisional application has been received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114 was filed in this application after appeal to the Board of Patent Appeals and Interferences, but prior to a decision on the appeal. Since this application is eligible for continued examination under 37 CFR 1.114 and the fee set forth in 37 CFR 1.17(e) has been timely paid, the appeal has been withdrawn pursuant to 37 CFR 1.114 and prosecution in this application has been reopened pursuant to 37 CFR 1.114. Applicant's submission filed on 24 November 2003 has been entered.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1-16, 27, 28, 30-32, and 39 are rejected under 35 U.S.C. 103(a) as being unpatentable over Groot (US 6,359,692) in view of Suematsu *et al.* (Applied Optics 30:4046-4055, 1991).

In regard to claim **39**, Groot discloses (Fig. 1) an interferometry system for characterizing a test object, the system comprising:

(a) a frequency-tunable light source (22, 24);

(b) an interferometer comprising at least one reference surface (36), wherein during operation the interferometer directs different portions of an optical wave front

derived from the light source (22, 24) to multiple surfaces of the test object (40) and the at least one reference surface (36) and recombines the different portions to form an optical interference image, the multiple surfaces of the test object (40) and the at least one reference surface (36) defining a set of cavity surfaces;

(c) a multi-element photo-detector (32, 33) positioned to record an interference signal at different locations of the optical interference image in response to frequency tuning of the light source (22, 24), wherein the interference signal includes a contribution from each pair of different surfaces in the set of cavity surfaces; and

(d) an electronic controller (60) coupled to the light source (22, 24) and the photo-detector (32, 33).

The system of Groot lacks that during operation the controller, for each location, calculates a frequency transform of the interference signal at a frequency corresponding to each of selected pairs of the different surfaces in the set of cavity surfaces and extracts the phase of the frequency transform at each of the frequencies corresponding to the selected pairs of surfaces. (OFDR) optical frequency domain reflectrometry is known in the art. Suematsu *et al.* teach (first left column paragraph on pg. 4047) that OFDR is used to read distance of multiple reflectors from the location of spectrum peaks appearing in the frequency spectrum of an interferometric signal and to transform the interference signal into the frequency domain (using, for example, a Fourier transform such as a Fast Fourier transform and a window function such as a Hanning window; first left column paragraph on pg. 4051) in order to determine the phase accurately by excluding unwanted influences (the lines between Eqs. 10 and 11 in the

left column on pg. 4048) and identifying (lines 1-3 on right column on pg. 4048) a frequency corresponding to each of one or more selected pairs of surfaces from the frequency domain representation of the interference signal. Groot teaches (column 6, lines 16-18) that distance h(x,y) is proportional to a phase θ(x,y) which can be determined by comparing imaginary and real part of the frequency domain representation of the interference signal at a selected frequency (Eqs. 9 and 10). Therefore it would have been obvious to one having ordinary skill in the art at the time of the invention to provide OFDR analysis of the interferometry data in the system of Groot, in order to determine a phase and optical path distance for each of the selected pairs of surfaces.

In regard to claims **1**, **3**, and **5-7**, the method steps are implicit for the modified apparatus of Groot since the structure is the same as the applicant's apparatus of claim 39.

In regard to claims **2** and **4** which are dependent on claim 1, the modified method of Groot comprises identifying (see lines 1-3 on right column on pg. 4048 of Suematsu *et al.*) a frequency corresponding to each of one or more selected pairs of surfaces from the frequency domain representation of the interference signal. It should be noted that cavity surfaces inherently have relative positions (see M1, M2, M3, ... ,Mn in Fig. 2 of Suematsu *et al.*) that define nominal optical path length differences L_{mn} and nominal frequencies f_{mn} which are calculated from the frequency tuning rate α_o and L_{mn} (see Eq. 24 of Suematsu *et al.*) and that the identification of a frequency corresponding to each of one or more selected pairs of surfaces in a series of frequency peaks

inherently requires a comparison of the series of frequency peaks to calculated nominal frequencies.

In regard to claims **8-10** which are dependent on claim 1, the modified method of Groot lacks that the window function (*e.g.*, a Tukey window, or a Hamming window) is selected to reduce a contribution to the frequency transform at the frequency corresponding to one of the selected pairs of surfaces from at least one other pair of different surfaces in the set of cavity surfaces. Suematsu *et al.* teach ("B. Three-Beam Interferometry" pg. 4051-4053; Fig. 10) to isolate by filtering a frequency band corresponding to one of the selected pairs of surfaces from at least one other pair of different surfaces in the set of cavity surfaces. Therefore it would have been obvious to one having ordinary skill in the art at the time of the invention to select the window function (*e.g.*, a Tukey window such as a Hamming or Hanning window) in the modified method of Groot, in order to isolate a frequency band corresponding to one of the selected pairs of surfaces from at least one other pair of different surfaces in the set of cavity surfaces.

In regard to claim **11** which is dependent on claim 1, Groot also discloses (column 1, lines 10-13; column 6, lines 16-18) determining the surface profile of one of the test object surfaces based on at least some of the extracted phases.

In regard to claim **12** which is dependent on claim 1, Groot also discloses (column 1, lines 10-13; column 6, lines 16-18) determining a relative optical thickness profile between two of the test object surfaces based on at least some of the extracted phases.

In regard to claims **13** and **14** which are dependent on claim 1, Groot also discloses (column 1, lines 10-13; column 6, lines 16-18) determining the surface profile of multiple ones of the test object surfaces based on at least some of the extracted phases. It should be noted that cavity surfaces inherently have relative positions (see M1, M2, M3, ... ,Mn in Fig. 2 of Suematsu *et al.*) and thus a relative orientation is inherent between two of the profiled test object surfaces. Therefore determining the surface profile of multiple ones of the test object surfaces inherently determines relative orientation.

In regard to claim **15** which is dependent on claim 1, Groot also discloses (Fig. 1) that the at least one reference surface (36) comprises one reference surface (36).

In regard to claim **16** which is dependent on claim 15, Groot also discloses (Fig. 1) that the test object (40) has a partially transparent front surface (44) and a back surface (46), the front surface (44) positioned nearer to the reference surface (36) than the back surface (46), and wherein the front, back, and reference surfaces define a three-surface cavity.

In regard to claim **27** which is dependent on claim 1, Groot also discloses (Fig. 1) positioning the test object (40) relative to the at least one reference surface (36) to cause the optical path length difference for each of the pairs of different surfaces in the set of cavity surfaces to differ.

In regard to claim **28** which is dependent on claim 27, Groot also discloses (column 8, lines 8-18) positioning the test object relative to the at least one reference surface to cause contributions to the interference signals from second order reflections

in the set of cavity surfaces to occur at frequencies that differ from the frequencies corresponding to the selected pairs of surfaces.

In regard to claims **30-32** which are dependent on claim 1, the modified method and system of Groot lacks monitoring the frequency tuning with a wavelength monitor comprising an interferometer and calculating the frequency transform based on the monitored frequency tuning. Suematsu *et al.* teach ("A. Combination of the FFT with the Reference Technique" pg. 4050-4051; Fig. 4) to monitor the frequency tuning with a wavelength monitor comprising an interferometer (*i.e.*, reference interferometer in Fig. 4) and calculating the frequency transform based on the monitored frequency tuning in order to remove the influence of unwanted variations such as nonlinear and time varying current-wavelength characteristics of a frequency-tunable light source (*i.e.*, laser diode). Therefore it would have been obvious to one having ordinary skill in the art at the time of the invention to provide a reference interferometer in the modified method and system of Groot, in order to remove the influence of unwanted variations such as nonlinear and time varying current-wavelength characteristics of a frequency-tunable light source.

Allowable Subject Matter

4. Claims 17-26 and 29 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

5. The following is a statement of reasons for the indication of allowable subject matter: the instant application is deemed to be directed to an nonobvious improvement

over the invention patented in US Patent 6,359,692. The improvements comprise in combination with other recited elements, that the test object is positioned between two reference surfaces as recited in claims 17-26 and that the test object is positioned relative to the at least one reference surface such that the optical path lengths of successive, adjacent pairs of the cavity surfaces are substantially proportional to one another by a unique power of 3 as recited in claim 29.

Response to Arguments

6. Applicant's arguments filed 24 November 2003 have been fully considered but they are not persuasive.

Applicant argues that Suematsu explicitly disregards the phase of the Fourier transform since Suematsu states (prior to Eq. 19) to "eliminate the unknown constant phases φ_0 and φ_{R0}, we differentiate the phases and obtain instantaneous angular frequencies". Examiner respectfully disagrees. As indicated in a prior response to applicant's arguments concerning the instantaneous frequency, it should be noted that Eqs. 16-21 (*i.e.*, instantaneous frequency) are to be used when applying a reference technique. Suematsu specifically states (prior to Eq. 16) to "Note that by this technique we can determine the phase $\varphi(t)$ with the resolution exceeding 2π. Next we explain how to apply the reference technique to the phase obtained by the FTT". The key phrases are "Next" and "reference technique". Thus it is clear that Suematsu explicitly disclose a first technique that determines the phase $\varphi(t)$ with the resolution exceeding 2π.

Applicant also argues that Suematsu does not suggest extraction of the Fourier transform phase φ_0 since Suematsu determines the fringe signal phase

$\varphi(t) = \varphi_0 + 2\pi f_s t + \theta(t)$. Examiner respectfully disagrees. As noted by applicant, independent claims 1 and 39 recite the limitation extracting (or extracts) "the phase of the frequency transform". However, the claims fail to specify how the phase is extracted from the frequency transform. Thus any method which extracts "the phase of the frequency transform" falls within the scope of this claim limitation. As discussed above, Suematsu explicitly disclose a first technique that determines the phase $\varphi(t)$. It is important to recognize that $\varphi(t = 0) = \varphi_0$ (see Eqs. 2, 6-9, 14, and 15). Thus it is clear that Suematsu teach or suggest extracting "the phase of the frequency transform" as recited in the claims.

Conclusion

7. All claims are drawn to the same invention claimed in the application prior to the entry of the submission under 37 CFR 1.114 and could have been finally rejected on the grounds and art of record in the next Office action if they had been entered in the application prior to entry under 37 CFR 1.114. Accordingly, **THIS ACTION IS MADE FINAL** even though it is a first action after the filing of a request for continued examination and the submission under 37 CFR 1.114. See MPEP § 706.07(b). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any

extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Shun Lee whose telephone number is (703) 308-4860. The examiner can normally be reached on Monday-Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Porta can be reached on (703) 308-4852. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

SL

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